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| 09/912,278 | 07/24/2001 | Amir Said | 1006298-1 | 5635 |

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HEWLETT-PACKARD COMPANY
Intellectual Property Administration
P.O. Box 272400
Fort Collins, CO 80527-2400

| EXAMINER | |
|---|---|
| LAROSE, COLIN M | |
| **ART UNIT** | **PAPER NUMBER** |
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| Colin LaRose | |
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**BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES**

Application Number: 09/912,278
Filing Date: July 24, 2001
Appellant(s): SAID, AMIR

Hugh P. Gortler
For Appellant

**EXAMINER'S ANSWER**

This is in response to the appeal brief filed 19 April 2005 appealing from the Office action mailed 1 February 2005.

**(1) Real Party in Interest**

A statement identifying the real party in interest is contained in the brief.

**(2) Related Appeals and Interferences**

The examiner is not aware of any related appeals, interferences, or judicial proceedings which will directly affect or be directly affected by or have a bearing on the Board's decision in the pending appeal.

**(3) Status of Claims**

The statement of the status of claims contained in the brief is correct.

**(4) Status of Amendments After Final**

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

**(5) Summary of Claimed Subject Matter**

The summary of claimed subject matter contained in the brief is correct.

**(6) Grounds of Rejection to be Reviewed on Appeal**

The appellant's statement of the grounds of rejection to be reviewed on appeal is substantially correct. The complete listing of the grounds of rejection is as follows:

Claims 2, 12, 25, and 28-30 are rejected under 35 U.S.C. 103(a) as being unpatentable over U.S. Patent 6,329,819 by Manduca et al. ("Manduca") in view of U.S. Patent 5,271,064 by Dhawan et al. ("Dhawan").

Claims 5-8, 14-16, and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manduca in view of Dhawan, as applied to claims 2, 12, and 25 above, and further in view of U.S. Patent 5,377,018 by Rafferty.

Claims 3, 13, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manduca in view of Dhawan as applied to claims 2, 12, and 25 above, and further in view of U.S. Patent 5,481,620 by Vaidyanathan.

Claims 4 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manduca in view of Dhawan and Vaidyanathan, as applied to claims 3 and 26 above, and further in view of U.S. Patent 5,594,807 by Liu.

[In paragraph 10 of the Final Rejection, claims 5 and 20 were mistakenly denoted as rejected as unpatentable over Manduca in view of Rafferty. It should have been: Manduca in view of Dhawan, as applied to claims 2 and 25, and further in view of Rafferty.]

**(7) Claims Appendix**

The copy of the appealed claims contained in the Appendix to the brief is correct.

**(8) Evidence Relied Upon**

| | | |
|---|---|---|
| 6,329,819 | MANDUCA ET AL. | 12-2001 |
| 5,271,064 | DHAWAN ET AL. | 12-1993 |
| 5,377,018 | RAFFERTY | 12-1994 |
| 5,481,620 | VAIDYANATHAN | 1-1996 |

**(9) Grounds of Rejection**

The following ground(s) of rejection are applicable to the appealed claims:

<u>Claims 2, 12, 25, and 28-30</u> are rejected under 35 U.S.C. 103(a) as being unpatentable over Manduca in view of U.S. Patent 5,271,064 by Dhawan et al. ("Dhawan").

Regarding claim 2, Manduca discloses a method for detecting an edge in a digital image block, the method comprising determining an entropy of pixel (luminance) differences in the

block (column 5, line 43 through column 6, line 10: equation 2 computes the entropy of pixel gradients for an image block, with the entropy indicating the presence and lucidity of edges within the block).

Regarding claims 2, 12, 25, and 28, Manduca discloses a method for detecting an edge in a digital image block, the method comprising determining an entropy of pixel (luminance) differences in the block, as established for claim 1.

Manduca is silent to creating an histogram of the pixel luminance differences, and then computing the entropy from the histogram.

Dhawan discloses a system for smoothing regions and enhancing edges in gray scale images. In particular, Dhawan discloses computing the entropy of a local area, and then using the entropy calculation to determine when to terminate enhancement. As shown in figure 8, local contrast vectors (i.e. gradients) are compiled into a contrast histogram, and then the entropy of the local area is calculated using the contrast histogram.

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Manduca by Dhawan to achieve the claimed invention since Dhawan shows that computing the entropy of a local area is conventionally realized by creating an histogram of gradients and then computing the entropy from the histogram.

Regarding claims 12 and 25, Manduca discloses the apparatus and article for the corresponding method of claim 1 (see figure 1).

Regarding claims 29 and 30, Manduca discloses a processor and article for the corresponding method of claim 28 (see figure 1).

Claims 5-8, 14-16, and 20-22 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manduca in view of Dhawan, as applied to claims 2, 12, and 25 above, and further in view of U.S. Patent 5,377,018 by Rafferty.

Regarding claims 5 and 20, Manduca is silent to determining the maximum pixel difference in the block (and using the maximum difference to determine whether the block contains an edge).

Rafferty discloses an image processing system that employs a routine to determine whether an edge is present in an image block (figure 6A). In particular, Rafferty discloses computing a maximum pixel difference in the block (70) in order to determine whether the block contains an edge (74,76).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Manduca by Rafferty to determine the maximum pixel difference (and to use the maximum difference to determine whether the block has an edge), as claimed, since Manduca is concerned with ascertaining the quality of edges within image blocks (column 5, lines 48-65), Rafferty shows that the actual presence of edges within a block is determined by comparing the maximum pixel difference to a threshold (figure 6A), and the maximum pixel difference denotes how much variation, or entropy, is present in the block (column 3, lines 15-24).

Regarding claim 6, Rafferty discloses comparing the maximum pixel difference to a threshold to determine whether the block contains an edge (70, figure 6A), and Manduca discloses comparing the entropy to a tolerance level to determine whether the edge is present and is of suitable quality.

Regarding claims 7 and 21, Rafferty teaches that a high maximum difference corresponds to a block with edges (70 and 76, figure 6A), and Manduca teaches that sharp edges are characterized by low entropy (column 5, lines 50-59).

Regarding claims 8 and 22, Rafferty teaches that a block is identified as not having an edge if the maximum difference is zero (according to blocks 70-76, figure 6A, the maximum difference must be at least greater than zero for the block to contain an edge).

Regarding claim 14, Manduca is silent to determining the maximum pixel difference in the block (and using the maximum difference to determine whether the block contains an edge).

Rafferty discloses an image processing system that employs a routine to determine whether an edge is present in an image block (figure 6A). In particular, Rafferty discloses computing a maximum pixel difference in the block (70) in order to determine whether the block contains an edge (74,76).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Manduca and Dhawan by Rafferty to determine the maximum pixel difference (and to use the maximum difference to determine whether the block has an edge), as claimed, since Manduca is concerned with ascertaining the quality of edges within image blocks (column 5, lines 48-65), Rafferty shows that the actual presence of edges within a block is determined by comparing the maximum pixel difference to a threshold (figure 6A), and the maximum pixel difference denotes how much variation, or entropy, is present in the block (column 3, lines 15-24).

Regarding claim 15, Rafferty discloses comparing the maximum pixel difference to a threshold to determine whether the block contains an edge (70, figure 6A), and Manduca

discloses comparing the entropy to a tolerance level to determine whether the edge is present and is of suitable quality.

Regarding claim 16, Rafferty teaches that a high maximum difference corresponds to a block with edges (70 and 76, figure 6A), and Manduca teaches that sharp edges are characterized by low entropy (column 5, lines 50-59).

Claims 3, 13, and 26 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manduca in view of Dhawan as applied to claims 2, 12, and 25 above, and further in view of U.S. Patent 5,481,620 by Vaidyanathan.

Regarding claims 3, 13, and 26, Manduca and Dhawan are silent to utilizing a look-up table to store the entropy of the histogram, as claimed.

Vaidyanathan discloses an image processing system wherein entropy values of an histogram are calculated (B, figure 2), and then the entropy values are stored in a look-up table (C, figure 2). Vaidyanathan teaches that storing the values in a look-up table allows a simple look-up operation to be performed in lieu of subsequent re-calculations (column 6, lines 61-65).

It would have been obvious to one of ordinary skill in the art at the time of the invention to modify Manduca and Dhawan by Vaidyanathan to achieve the claimed invention by pre-computing the bin entropies of the histogram for storage in a look-up table and then utilizing the look-up table to determine the entropy of the histogram, as claimed, since Vaidyanathan teaches that storing the pre-computed entropy values in a look-up table negates the need to re-calculate the entropy values for each bin and allows for easy access of the entropy values.

Claims 4 and 27 are rejected under 35 U.S.C. 103(a) as being unpatentable over Manduca in view of Dhawan and Vaidyanathan as applied to claims 3 and 26 above, and further in view of U.S. Patent 5,594,807 by Liu.

Regarding claims 4 and 27, Vaidyanathan is silent to scaling or rounding the numbers in the look-up table to integers. Liu discloses truncating or rounding numbers to be stored in a look-up table to integers, since it eases pre-computation and storage of the values (column 12, lines 1-5). At the time the invention was made, rounding numbers to be stored would have been an obvious expedient for the purposes of reducing the size of the table to be stored.

**(10) Response to Argument**

Appellant's arguments regarding independent claims 2, 12, 25, and 28 and dependent claims 3-4, 13, 26-27, and 29-30 appear on pp. 4-6 of the Appeal Brief:

Argument 1: Claim 2, which is a representative claim, is directed to "a method of detecting edges in a digital image block." Appellant's first argument is that Manduca does not appear to disclose "edge detection" (Brief, p. 4). Rather, Appellant argues, Manduca describes determining a "measure of image quality" (Brief, p. 5).

Assuming, *arguendo*, that the preamble language, "detecting edges in a digital image block," is "necessary to give life, meaning, and vitality to the claim"[1] and does not merely recite an intended used of the claimed method, the Examiner believes that such a limitation does not render the claim patentably distinct from the cited prior art because it is fairly disclosed by Manduca.

[1] MPEP § 2111.02; Pitney Bowes, Inc. v. Hewlett-Packard Co., 182 F.3d 1298, 1305, 51 USPQ2d 1161, 1165-66 (Fed. Cir. 1999).

Appellant correctly points out that Manduca's metric (*i.e.* equation (1), column 5) provides a measure of the "quality" of the image block to which it pertains. It should be noted, however, that this metric disclosed by Manduca at column 5, lines 43-65, measures the quality of *edges* present in a given image block. For instance: "The quantity [of the metric] is minimized when the image consists of areas of uniform brightness, separated by sharp edges, since in such a case, the gradient is zero everywhere except at the edges, where it has high values. * * * Any blurring or ghosting will increase the entropy of the gradient, since the gradient will be non-zero at more points and will take on smaller values at the actual edge location." (Manduca, column 5/50-59).

The above passage in Manduca teaches that in an area of uniform brightness, i.e., an area having no edges, the metric will effectively be zero since the gradient function $h$ is essentially zero over the entire area. Accordingly, when there are variations in pixel values, or edges, present in the given area under observation, non-zero pixel gradients will exist, thereby rendering the metric non-zero. Therefore, the image quality metric, first and foremost, denotes whether edges *exist* in the observed area. Edges, characterized by variations of pixel values, are "detected" when the metric is non-zero.

While the metric is operative to detect edges, its primary function, as disclosed by Manduca, is to ascertain the *quality* of the detected edges. For example, are the edges smooth and blurry, or crisp and sharp? This functionality of the metric is beyond the scope of the claim, which merely calls for the "detection" of edges and is not concerned with determining the relative quality or characteristics of any detected edges.

Accordingly, Manduca's image quality metric is considered to effectively detect the presence of "edges."

Argument 2: Appellant asserts that Manduca "does not teach or suggest computing entropies of histograms" (Brief, p. 6). This assertion is correct insofar as the Examiner admitted that Manduca does not disclose such a limitation. According to the Final Rejection (see rejection of claim 2 above), "Manduca is silent to creating an histogram of the pixel luminance differences, and then computing the entropy from the histogram."

Thus, it has been previously established that Manduca computes measures of entropy using the gradients of pixel values (i.e. differences in pixel luminance) rather than using histograms of gradients. As recited above, Dhawan was relied upon to cure such a deficiency in Manduca and demonstrate that such a modification of computing entropy from histograms of gradients would have been an obvious modification to those skilled in the art at the time the invention was made.

Argument 3: Appellant asserts that the rejections of the claims in question should be withdrawn because "neither Dhawan et al. nor Manduca et al. teach or suggest edge detection in a pixel block by computing the entropy of a histogram of the pixel block." It should be noted that the Examiner has previously admitted as much.

Neither Manduca nor Dhawan, taken separately, fully disclose "edge detection in a pixel block by computing the entropy of a histogram of the pixel block." That is, Manduca or Dhawan are considered to qualify as prior art under 35 U.S.C.§ 102.

However, the combined teachings of Manduca and Dhawan render the claims unpatentable because "the differences between the subject matter sought to be

patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains." [2]

Appellant has not provided sufficient facts, legal analysis, or reasoning as to why the § 103 rejections of independent claims 2, 12, 25, and 28 are improper. Appellant has merely argued that Manduca and Dhawan, taken separately, are not available as prior art under § 102.

The Examiner has presented a *prima facie* case of unpatentability under § 103 based on reasonable interpretations of both the claimed subject matter and the cited prior art. The above rejections should be maintained since Appellant has not directly addressed their merits, as pertains to the *combination* of Manduca and Dhawan.

Dhawan was relied upon for demonstrating that, for the purposes of computing a measure of local entropy in a digital image, it is both conventional and well-known to compile gradient pixel values into an histogram prior the computation of the entropy. In other words, utilizing a gradient histogram rather than simply gradient values is a conventional technique for computing a measure of entropy in a local neighborhood of a given image, and those skilled in the art, upon reading Dhawan's disclosure, would have recognized that such a technique is an alternative means for achieving the same end -- a measure of local entropy.

Appellant's arguments regarding <u>dependent claims 5-8 and 20-22</u> appear on p. 7 of the Appeal Brief:

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[2] See 35 U.S.C. § 103(a)

Appellant argues that the rejections of claims 5 and 20 should be withdrawn because Manduca is "silent about improving edge detection in the presence of noise" and "Rafferty does not teach or suggest how this technique can be used to distinguish noise from edges." It does not appear that these arguments are relevant to the claim language, since neither claim 5 nor claim 20 (nor any of claims 6-8 and 21-22) mention or have anything to do with "noise."

Appellant also alleges that Rafferty "does not teach or suggest combining [the claimed] technique with entropy of histogram of pixel luminance differences." The Examiner has presented a *prima facie* case of unpatentability under § 103 based on reasonable interpretations of both the claimed subject matter and the cited prior art. Appellant has not directly addressed the merits of the rejections and has merely alleged that the references are not combinable without providing any supporting rationale or analysis. Accordingly, the rejections of claims 5-8 and 20-22 should be maintained.

Appellant's arguments regarding <u>dependent claims 14-16</u> appear on pp. 8 of the Appeal Brief:

Appellant alleges that Rafferty and Dhawan do not teach or suggest combining the maximum pixel difference in the block with entropy of a histogram of the block." The Examiner has presented a *prima facie* case of unpatentability under § 103 based on reasonable interpretations of both the claimed subject matter and the cited prior art. Appellant has not directly addressed the merits of the rejections and has merely alleged that the references are not combinable without providing any supporting rationale or analysis. Accordingly, the rejections of claims 5-8 and 20-22 should be maintained.

Rafferty's disclosure teaches that the "maximum pixel difference" in a block of image data provides a measure of the entropy of the image block (column 3, lines 15-24). This measure of entropy can be compared to a threshold to determine whether an "edge" is present in the image block, according to figure 6A of Rafferty. Therefore, Rafferty stands for the proposition that comparing the entropy of an image block to a threshold can effectively detect edges in an image block. Accordingly, it would have been obvious to compare at least Manduca and Dhawan's histogram-of-gradients entropy metric and Rafferty's maximum pixel difference metric to a threshold to determine the presence of edges.

**(11) Related Proceeding(s) Appendix**

No decision rendered by a court or the Board is identified by the examiner in the Related Appeals and Interferences section of this examiner's answer.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Colin LaRose

Conferees:

JOSEPH MANCUSO
SUPERVISORY PATENT EXAMINER

Joe Mancuso

Bhavesh Mehta

BHAVESH M. MEHTA
SUPERVISORY PATENT EXAMINER
TECHNOLOGY CENTER 2600